

# Prevention of Degenerative Heart Disease by Neurovegetative Reconditioning

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**I**N RECENT YEARS survivors of critical cardiac episodes in impressive numbers have been returning after rehabilitation to gainful employment and conventional living, thanks to advances in diagnostic and curative medicine, notably in surgery.

In contrast, little has been done to prevent the development of widespread cardiac diseases such as myocardial degeneration and infarction, angina pectoris, hypertensive heart disease, and congestive heart failure, as witnessed by the extremely high morbidity and mortality figures in highly industrialized countries, particularly in the United States. While prophylactic medication, such as penicillin for rheumatic heart disease, has had remarkable results, only a few attempts have been made in this country to organize preventive reconditioning of cardiac pre-patients through management of environment and behavior. Fortunately, because the participation of neurovegetative pathogenic factors in myocardial degeneration has been considerably illuminated in recent years, the rationale of such preventive practices is steadily gaining in scientific validity.

## Neurogenic Factors

Traditional American cardiology still tends to focus primarily on factors which determine the oxygen supply to the heart muscle, since the

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mechanism of obstructed coronary flow is decisive in coronary occlusion. Occlusions, however, are not generally responsible for widespread chemical alterations, multiple focal necroses, and fibrotic changes which contribute to the development of cardiac failure. Recent studies have given more attention to the dominant role of the sympathetic nervous system and its neurohormones (catecholamines, norepinephrine, and epinephrine) in determining oxygen consumption by the ventricular myocardium. Neither the coronary flow and oxygen supply nor the neurohormone-regulated oxygen consumption alone decide the fate of the heart muscle, since its oxygen economy depends on the mutual quantitative relationship of both factors. Russian cardiologists distinguish explicitly between myocardial lesions which are prevailingly due to coronary impairment and others which are caused chiefly by neurogenic factors or to a combination of both (1).

The pathogenic basis of the most common forms of myocardial degeneration is summarized below with a view to the possibility of prevention. There are six cardinal points dealing with the neurovegetative (neurohormonal) interference in the function, metabolism, and health of the heart muscle. The literature on this subject, far too abundant to be quoted in detail, has been extensively reviewed elsewhere (2-4).

1. The sympathetic nervous system acts upon the heart muscle directly by discharging norepinephrine into the myocardial cells, and indirectly by mobilizing epinephrine from the adrenal medulla into the bloodstream (2).

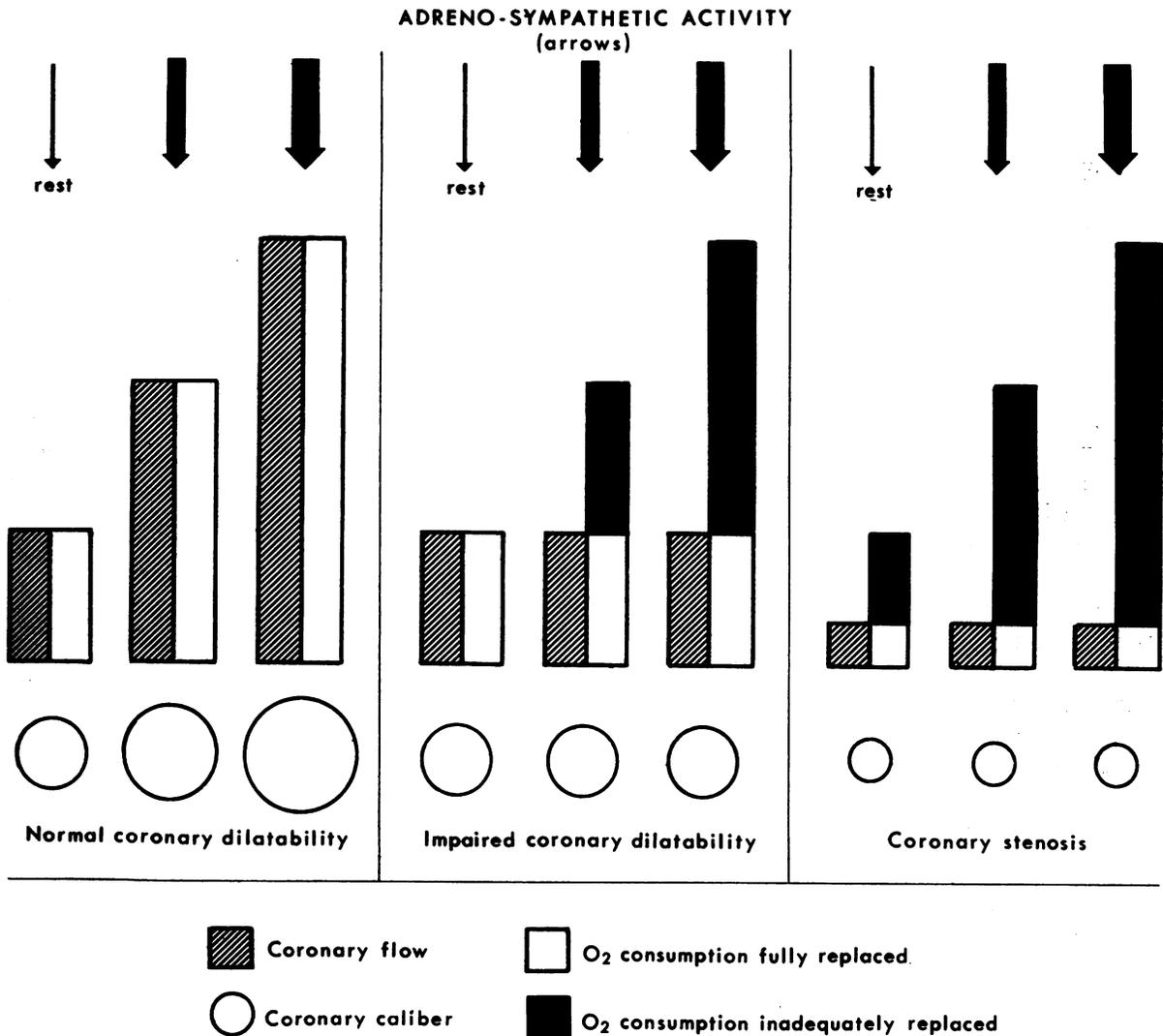
2. Both norepinephrine and epinephrine greatly augment myocardial oxygen consump-

tion, far beyond the actual requirements for the external mechanical work performed (2).

3. Normally, the sympathetic catecholamine-induced increase of myocardial oxygen consumption is paralleled by a compensatory dilatation of the coronary arteries which effectively prevents local hypoxia (4).

4. Whenever this compensatory mechanism fails because of impairment of coronary dilatability (for example, sclerosis), the vulner-

ability of the heart muscle to sympathogenic catecholamine action rises in proportion to the rising discrepancy between vascularly regulated coronary oxygen supply and neurohormone-regulated myocardial oxygen consumption, as shown in figure 1 (4). Myocardial vulnerability is maximal in the subendocardial layers of the left ventricle because of additional interference of the intraventricular pressure with the capillary blood flow through these layers.



**Figure 1.** With increasing sympathetic stimulation or preponderance (arrows) and with decreasing compensatory coronary dilatability (circles), the discrepancy (black) between coronary oxygen supply on the one hand (shaded left areas) and catecholamine-induced additional myocardial oxygen consumption on the other (right areas) will increase. This leads to anoxia in certain cell groups of the heart

muscle (especially in the subendocardium), the blood and oxygen supply of which is "handicapped" by intraventricular pressure, shortening of the diastolic perfusion period, and premature exhaustion of the oxygen stores of passing erythrocytes because of excessive oxygen consumption by other myocardial cells, located further upstream. (Source: Reference 4.)

Multiple foci of anoxia, necroses, and fibrosis are the common results (4).

5. All forms of stress, including emotional tensions, anxieties, and frustrations, are accompanied by reflex augmentations of sympathetic neurosecretory activity with corresponding repercussions on myocardial function and metabolism (4). Tobacco smoking produces similar effects by way of stimulation of the sympathetic ganglia.

6. Physical exertion is likewise accompanied by intense, acute sympathetic stimulation. However, prolonged habitual exercise training leads to the development of a sustained (central nervous?) basal sympatho-inhibitory plus vagal counter-regulatory mechanism (manifested by the typically reduced sympathetic tone of the slow-beating, highly efficient "athlete's heart"), whereas lack of physical exercise produces the opposite: the fast-beating, inefficient, and prognostically endangered sympathicotonic "loafer's heart," as shown in figure 2 (3,5).

Industrialized, motorized, and urban living disturbs the neurovegetative equilibrium of cardiac metabolic regulation by (a) exaggerated socioeconomic, emotional, environmental, and sensory stimulations of the sympathetic system, and (b) a deficiency of the counter-regulatory sympatho-inhibitory plus vagal mechanism, induced by a low level of physical activity. Urban environment and sedentary living habits thus contribute to an unduly sustained cardiac sympatho-adrenergic preponderance, as shown in figure 3 (6). The high sympathetic tone of the short-lived domestic rabbit (4-5 years, 60-80 heartbeats per minute) in contrast to the field hare (10-14 years, 16-18 heartbeats per minute) seems to represent a suggestive analogy.

An adrenergic preponderance in the regulation of myocardial oxygen consumption appears to have no ill effects per se as long as compensatory coronary dilatability is well maintained (see point 3 above). Sclerotic impairment of this function, however, a common phenomenon even in relatively young Americans (4), greatly augments the potential dangers of any neurovegetative stress to the integrity of the heart muscle.

In primitive man, the fight and flight reflexes accelerated the heartbeat and dilated the ar-

teries of the active muscles to facilitate the flow of oxygen to these muscles. Today, as the heart and arteries respond to occasions of fear or anger, civilization has frustrated the appropriate muscular outlet for these circulatory resources. This appears to be illustrated by the fact that the fall of diastolic blood pressure, indicating dilatation of the muscular arterioles, as it usually occurs during physical exertion, is either absent or replaced by a potentially detrimental rise of the diastolic pressure during emotion

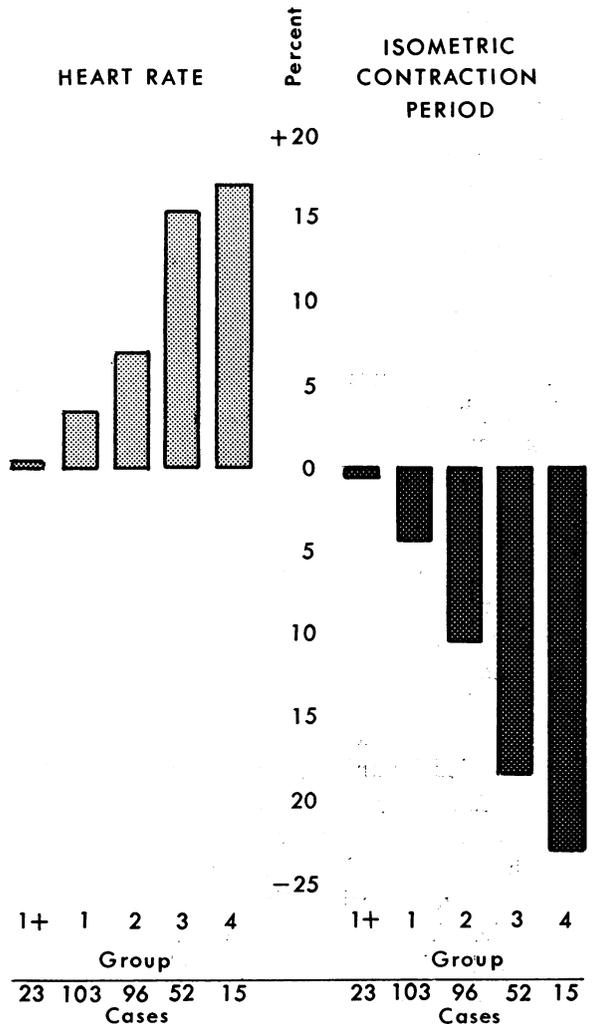


Figure 2. Increase of resting heart rate and shortening of isometric contraction period of left ventricle (sympathetic adrenergic preponderance) in proportion to decreasing exercise habits in groups of healthy young men, aged 17-34 years, ranging from competitive athletes (group 1+) to completely sedentary individuals (group 4). The same pattern was found in older age groups (from 35 to 50 years). (Source: Reference 3.)

without motion. This may explain why some angina pectoris patients are affected more by emotional stress than by exercise. Exaggerated acute discharges of sympathogenic catecholamines have been observed in angina patients under both emotional and physical stresses by several investigators (4). Emotional excitement also raises the blood level of lipids and free fatty acids (7).

Clinical manifestations of angina pectoris, hypertensive heart disease, and congestive heart failure have been the object of a variety of antiadrenergic pharmacological and surgical devices: sympathectomy, ganglionic blockade, catecholamine-depleting drugs, catecholamine-inactivating thyroidectomy and thyrostatic drugs, sympathetic inhibition and vagal stimulation by carotid sinus pressure, and vagus-stimulating morphine.

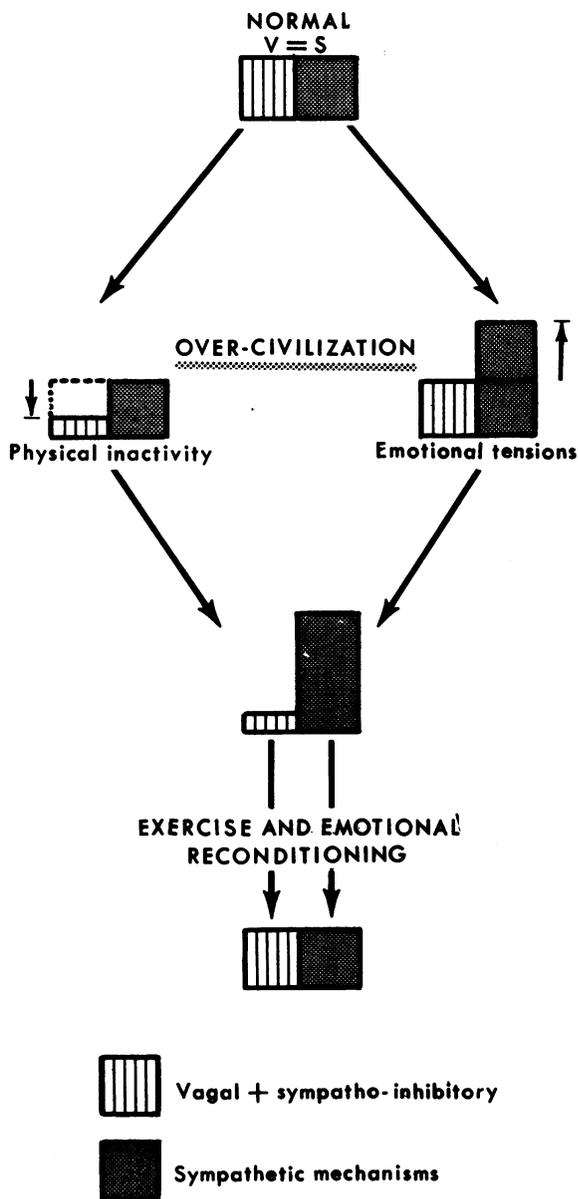
Obviously it is more rational to attempt prevention of the neurogenic biochemical antecedents and clinical manifestations of degenerative heart disease at a premonitory stage by early corrective measures. These consist primarily of (a) physical training to restore antisymphathetic counter-regulation (3,8), and (b) reduction of sympathetic-stimulating environmental-emotional stresses (figs. 2 and 3) and of tobacco smoking. Cold water applications have likewise been used with this objective (9). In addition, physical training is believed to stimulate the development of collateral coronary arteries (10), and Selye has concluded that "pretreatment with . . . cold baths or muscular exercise is the most generally cardioprotective agent so far revealed by animal experimentation" (11).

The following passages are confined to the cardiac features of preventive reconditioning. Further information concerning orthopedic, respiratory, gastrointestinal, and general psychological health benefits from reconditioning systems has been published elsewhere (9,12).

### Preventive Reconditioning Abroad

Advocacy of outdoor life, fresh air and sunlight, walking, gymnastics, and hydrotherapy has expressed the empirical judgment of physicians and distinguished laymen from Jean Jacques Rousseau to Theodore Roosevelt, and more recently, Dr. Paul D. White. Systematic

and large-scale applications of these policies under conditions which permit some evaluation have been developed in the U.S.S.R., in West



**Figure 3.** Schematic representation of civilization-induced imbalance between vagal plus sympatho-inhibitory mechanisms (V) on the one hand, and sympathetic influences (S) on the other, causing a potentially detrimental sympathetic-adrenergic preponderance in cardiac metabolism. Restoration of the adrenergic-antiadrenergic (vagal plus sympatho-inhibitory) equilibrium is possible by emotional adjustment and physical training. These principals are applied on a large, organized scale in about 3,000 European and Soviet preventive reconditioning centers on several million persons per year. (Source: Reference 6.)

Germany, and in some other European countries since 1919 (9,13). Extensive references to the pertinent German, Russian, and Czech literature are included in a special brochure, "Organized Prevention of Degenerative Heart Disease" (13).

Shortly after the Bolsheviki gained power in Russia, N. A. Semashko converted a number of private country estates into public reconditioning centers: sanatoriums, rest homes, and recreational areas. Since then, many institutions of this kind have been constructed. In 1961, 2,100 such centers, *kurorty*, were operated jointly by the government and labor unions. The largest and most elaborate centers are situated along the subtropical coast of the Black Sea and in the Caucasus Mountains. Annually, about 5 million patients use such accommodations, with an average stay of 4 weeks. About half these patients are reported to suffer from specifically diagnosed pathological conditions requiring rehabilitation. The others are selected as candidates for preventive reconditioning by committees at their places of work. Priority is given those in important tasks and those credited with superior achievements. The medical criteria for issuance of an admission ticket (*putyovka*) include signs of excessive fatigue and a variety of poorly defined and often merely subjective nervous or circulatory symptoms.

Sojourn in the *kurorty* differs markedly from the conventional, unsupervised country vacation. The patient's stay is aimed to provide a complete change of physical and emotional environment, with the advantages of spaciousness and opulence, in contrast to the familiar confinement and austerity of Soviet everyday working life. Simultaneously, patients receive systematic physical training, appropriate to their conditions, under medical supervision and guidance by physical educators. This *fizkultura* includes group calisthenics, hiking, mountain climbing, sports and games, swimming, and rowing. Certain spas also emphasize carbon dioxide or sulfur baths. Fats and salt in the diet are restricted.

Labor unions provide similar reconditioning in so-called night-sanatoriums on the precincts of industrial plants, where workers may spend off-duty time for several weeks, usually eve-

nings and nights. During the working day, production is interrupted by exercise breaks of 5 to 10 minutes with music. Facilities for sports and athletic events are also considered an aspect of the preventive reconditioning program under the direction of 70,000 physical educators. With a population of more than 200 million, the Soviet Union reports more than 1,400 sports arenas and stadiums, 7,000 gymnastic halls, 25,000 football fields, and 200,000 ball game areas.

Similar arrangements exist in East Germany and in Czechoslovakia, where about 800 centers accommodate 660,000 persons a year.

In West Germany, reconditioning centers are financed by industrial corporations, such as the Siemens and Halske Electrical Works and Opel Automobile Industries, and by regional health insurance organizations (*Landesversicherungsanstalten*). Since 1954, when the first center, sponsored by the University of Munich, was founded by Dr. P. Beckmann, 20 more have been organized to admit about 20,000 reconditioning candidates per year. Since 1957, every insured worker in the German Federal Republic is entitled to a stay at a reconditioning center upon recommendation by his plant or insurance physician, at no charge and no loss of earnings. Stays are from 4 to 6 weeks. Primary recommendations frequently come not from the physician but from the supervisor who observes fatigue, loss of efficiency, or emotional instability. Refusal to accept reconditioning may jeopardize pension rights. Two centers are reserved for women.

Centers in West Germany, Switzerland (four), and Austria (four) stress rural scenic beauty and simplicity of accommodations as a change of environment, in contrast to the opulence of the Soviet centers. The West German center, Schloss Schönberg, accommodates 140 mine workers in an adapted medieval castle. A condensed version of its routine is shown in table 1. Other centers, for sedentary workers, devote more time to hiking.

Lectures and demonstrations at these centers encourage indefinite continuation of home exercises without equipment, hiking and sports activities, avoidance of elevators and of unnecessary passive transportation, reduction of fats in the diet, and abstention from tobacco

smoking. Instruction in handicraft and hobbies is aimed to develop relaxing, yet gratifying activities, free of emotional stress.

### Neurovegetative Cardiac Status

Sufficient data for evaluating the long-range effect of these preventive services are not yet available. West German institutions assert that pertinent information is being collected but that the time is still insufficient to permit a definite appraisal of the facts. Statistics obtained over a period of 40 years by the Soviets have not been published. The only appraisals obtainable from the U.S.S.R. Ministry of Health are general expressions of optimism (13,14).

In the absence of unequivocal records from other countries, the United States, with its high rate of mortality from degenerative heart disease, has little choice but to pursue every promising lead for the prevention of cardiovascular disorders. In this spirit, the American Heart Association and the American Medical Association have reiterated earlier recommendations against an excess consumption of saturated fats (15-17). These recommendations are intended to counteract solely the vascular detriments, resulting from widespread dietary habits, which endanger the adequate adaptation of coronary blood flow and oxygen supply to the neurohormone-regulated fluctu-

**Table 1. Weekly distribution of reconditioning activities at Castle Schönberg Reconditioning Center, West Germany**

Activity	Number of days	Periods (minutes)	Total (hours)
Calisthenics, breathing exercises, massage, skin brushing, early morning running	6	45	4½
Sports	2	90	3
Hiking in groups			9
Baths, water applications	3	20	1
Sauna baths			2
Relaxation practices	3	60	3
Lectures on health problems	3	40	2
Handicraft	2	120	4
Evening entertainments			3½

SOURCE: W. Schauwecker: *Ärztl. Mitteilgn.* 45: 276 (1960).

**Table 2. Cardiovascular differences between "normal" and trained individuals at rest**

Parameter	Normal average	Trained subjects	
		Average values	Extreme values
Heart rate per minute	72	47	32
Blood pressure (systolic)	130	115	95
Blood pressure (diastolic)	75	80	65
Stroke volume (cc.)	75	44	30
Cardiac output (liter per minute)	5.5	2.1	1.3
Isometric period, left ventricle (seconds)	.08	.11	.16

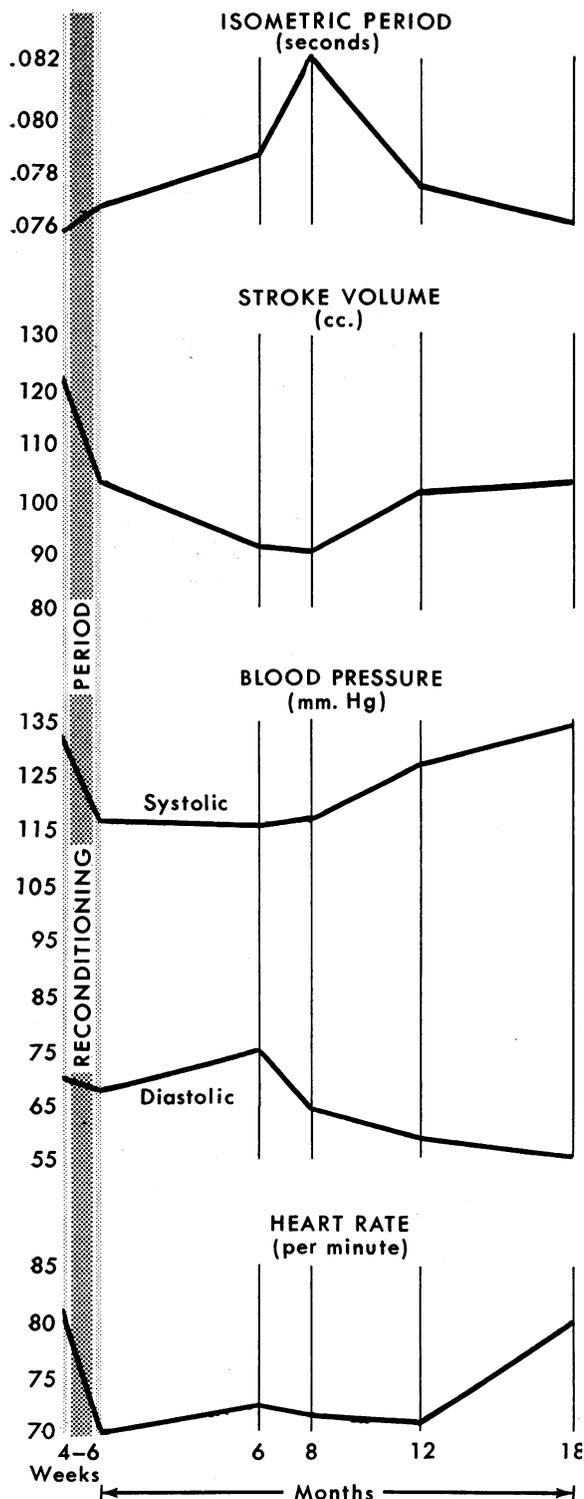
SOURCE: Reference 18.

ations of myocardial oxygen requirements. However, there is equally valid reason for the recommendation of attempts to correct potentially pathogenic imbalances in the neurovegetative regulation of myocardial oxygen consumption. Besides, academic studies concerning the role of the autonomic nervous system in the origin of myocardial degeneration need to be continued with much greater emphasis than in the past, and at an accelerated pace.

Several relatively simple measurements provide a means to evaluate objectively the basal status of neurovegetative myocardial functional and metabolic regulation. These include the resting heart rate, length of the isometric contraction period of the left ventricle, which is shortened by adrenergic and lengthened by antiadrenergic influences (3), auricular-ventricular conduction time, and urinary excretion of vanillin mandelic acid. Further information on cardiac sympathetic excitability may be obtained by measuring these parameters and the free fatty acid level in the blood under exposure to sensory stimuli (noise or flicker light), to mental and emotional stresses, during upward tilting, and in connection with standard exercises.

The benefits of physical training in shifting the neurovegetative cardiac equilibrium toward the antiadrenergic side have been studied extensively, as shown in table 2 (3, 8, 18).

Characteristic features of reduced cardiac sympathetic tone in trained individuals may be described as follows: (a) slow resting heart rate (3, 8, 19); (b) lengthened isometric contraction



**Figure 4.** Average reactions of neurovegetatively regulated cardiovascular parameters of 40 reconditioned trainees during 4 to 6 weeks' reconditioning period (shaded area) and the following 1½ years. Temporary shift toward antiadrenergic preponderance. (Source: Reference 28.)

period of the left ventricle at rest (3, 8); (e) prolongation of atrio-ventricular conduction time (20); (d) during exercise, relatively low maximum of cardiac acceleration and of steady-state heart rate (19); (e) following exercise, relatively short deceleration period (19); (f) even after heavy work, absence of hypoxic depressions of the S-T segment and of the T-wave of the electrocardiogram (21); (g) increased cardiac resistance to stress, manifested in the ballistocardiogram (22).

In contrast, the "loafer's heart" of sedentary individuals demonstrates a preponderance of adrenergic features, such as accelerated heart rate and short isometric periods at rest (3, 5). Numerous statistical studies strongly suggest a pathogenic significance of lack of exercise in degenerative heart diseases (12). Persons with a high-strung personality and emotionally stressful occupations, conducive to coronary heart disease, exhibit an augmented daytime excretion of catecholamines and of their metabolite, vanillin mandelic acid (23-26). In angina pectoris patients, sympatho-adrenal neurosecretory excitability is usually augmented (4). Baboons with experimentally induced chronic neuroses frequently develop severe myocardial lesions (27).

#### Reconditioning Data From Abroad

Objective clues to immediate and long-range effects of environmental relief in combination with physical training in the European reconditioning centers are not abundant, but the limited data available uniformly indicate a shift from cardiac adrenergic to antiadrenergic preponderance. Measurements at rest showed a reduction of the heart rate (28, 29) and prolongation of the isometric contraction period (28). Orthostatic sympathogenic depressions of S-T and T disappeared (personal communication from K. Rademacher, 1960). Persistence of these effects during approximately 1 year was observed in a followup study of 40 trainees, as shown in figure 4 (28). Furthermore, a prolonged lowering of elevated blood pressure levels, a dampening of psychomotor excitability, and an increased lung capacity have been reported by several observers from the Soviet Union and Germany (13). Additional evidence is hoped

**Table 3. General subjective improvement at termination of sojourn in 6 West German reconditioning centers**

Author	Number of cases	Markedly improved or free of symptoms	Moderately improved	Unimproved or worse
Blüthgen.....	390	348	21	21
Schauwecker....	128	102	21	5
Brusis (Ohlstadt).....	1, 558	1, 062	480	16
Brusis (Lütz)....	572	553	16	3
Rademacher.....	2, 240	2, 144	-----	96
Stirn and Stirn.....	159	121	34	4
Total.....	5, 047	4, 330	572	145
Percent.....	-----	85. 8	11. 3	2. 9

SOURCE: Reference 13.

for as a result of studies currently projected by West German, Austrian, Soviet, and American investigators.

Reports from European and Soviet centers are inclined to highlight subjective improvements of such largely neurovegetative symptoms as palpitations, fatigue, insomnia, shortness of breath, headaches, dizziness, mild chest oppressions, and cold hands and feet (table 3), thus reflecting the vague criteria by which many candidates are selected for centers. Evidently, the value of such appraisals is limited, but it would be unwise to disregard them entirely (table 4).

It should also be kept in mind that physical training per se is no panacea. Even highly trained athletes occasionally display intense emotional sympathogenic reactions, such as tachycardia and steep, peaked brachial pulse

waves (personal communication from T. K. Cureton, 1962), suggesting that environmental and emotional influences should also prove to be powerful factors in neurovegetative reconditioning. There is little doubt that the scenic beauty, the peaceful, pleasant surroundings, and the personal psychological approach of the medical staffs of the reconditioning centers contribute greatly to the well-being of the trainees, to a restoration of their self-confidence, and to their willingness to readjust their daily living habits in accordance with the health rule indoctrinations to which they are exposed at the centers.

This discussion has been concerned entirely with preventive reconditioning to avoid or delay pathological developments in the heart, without regard for claims made also for a rehabilitative improvement of patients with already clearly defined heart disease (13).

#### Morbidity and Mortality Experience

Soviet statements (14), which ascribe to cardiovascular conditions 198 male deaths per 100,000 population in the U.S.S.R. in contrast to the American figure of 578 in 1958, must be interpreted in the light of the average age of the population, average age of the deceased, physical activity, neurovegetative cardiac status, diet, and competing causes of mortality, before the effects of preventive reconditioning and connected health education can be conclusively evaluated. The quality of reporting also must be taken into account. The rapid increase in cardiac deaths in West Germany from 1950 to 1952 by nearly 100 percent was possibly precipitated by the rise in food consumption and a decline in physical exertion, as prosperity re-

**Table 4. Duration of subjective improvement**

Author	Number of cases	Percent improved up to—				Percent unimproved
		12-24 months	6-12 months	3-6 months	0-3 months	
Brusis (Ohlstadt).....	500	28. 6	42. 4	18. 4	-----	10. 6
Brusis (SKF Schweinfurt, University of Würzburg).....	153	16. 5	34. 9	37. 7	-----	10. 9
Stirn and Stirn.....	151	-----	27. 0	40. 0	33. 0	(?)

SOURCE: Reference 13.

turned to the land. By contrast, according to an official report from the Soviet Union (14), the cardiovascular mortality there decreased from 1939 to 1958. Both Germany and the Soviet Union suffered casualties in the early forties which may have distorted the mortality pattern of the fifties in both countries. However, their living conditions and habits are in sharp contrast, those in West Germany more nearly resembling the conditions in the United States than those in the U.S.S.R.

The relatively small number of only 20,000 persons per year affected by formal systematic reconditioning services in West Germany has been noted above. This number will increase foreseeably, to judge by reports of sponsoring industrialists and insurance directors. According to their observations, reconditioning of workers and employees reduces absenteeism and improves productivity. Among 1,502 West German trainees (table 5) with various cardiovascular complaints, absenteeism dropped 68.8 percent in the 2 years following 4 weeks' reconditioning as compared with the 2 preceding years (30).

The communist governments maintain their vast preventive reconditioning systems with the explicit motivation "to beat capitalism in the field of economy by preservation of manpower and increase of production" (9).

The impulse toward preventive action in this country is strengthened by the Framingham report (31) which concludes, "coronary heart disease demands a primarily preventive rather than therapeutic approach," and by many expressions of public opinion which demand

more active initiative in matters of preventive health preservation (13, 32).

It must be conceded that physical reconditioning in the United States, if any, now proceeds on a haphazard basis in the form of sports, recreation, hobbies, and vacations, without specific medical direction or supervision. If such activities were to become more organized, self-conscious, and deliberate, with records taken to appraise the value of specific behavior and services, they would be far more effective.

At least one pilot reconditioning center in a scenically and climatically favorable, preferably mountainous location, with research facilities and under scientific auspices, ought to be established in the United States, which is more severely challenged by degenerative heart disease than any other nation. Sedentary cardiologists, physiologists, health officers, and practitioners might serve as particularly well-suited test subjects, with the obligation to keep themselves available for systematic long-range followup tests.

### Summary

Large-scale arrangements for early prevention of cardiac degeneration have been established in several European countries by governments, industrial corporations, and insurance groups, through the operation of thousands of rural centers for environmental and physical reconditioning under medical supervision. Fatigued, but not yet overtly sick, individuals admitted to such centers experience environmental changes and physical exercise

**Table 5. Reduction of absenteeism after reconditioning in 3 West German reconditioning centers**

Author	Number of cases	Percent of absences from work during—		Estimated reduction of lost working time (percent)
		2 years before reconditioning period	2 years after reconditioning period	
Brusis.....	742	81.7	23.8	70.9
Blüthgen (quoted by Brusis).....	760	80.0	27.0	66.2
Total.....	1,502			
Average.....		80.8	25.4	68.6

SOURCE: Reference 30.

routines which aim at relaxing them emotionally and improving their general physical tone. The trainees also receive psychological counseling and systematic instructions for continuing home exercises, prescribed dietary patterns, and other hygienic practices.

Accumulated data concerning civilization-induced pathogenic neurohormonal and biochemical influences on the metabolism and structure of the heart muscle provide a strong rational support for such preventive treatment. However, extensive population studies with particular attention to the neurovegetative cardiovascular status (beside the much-investigated dietary factors) and to its modification by reconditioning periods will be necessary to demonstrate the precise immediate and long-range benefits of environmental and physical reconditioning.

Since the U.S. mortality from degenerative heart disease surpasses that of all other nations, the establishment of at least one scientifically conducted experimental reconditioning center in this country would constitute a logical step toward organized preventive management of the nation's most pressing health problem.

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## Safe and Nutritious Food Supply

The American food supply does not contain dangerous amounts of pesticide residues, and it can more than fulfill accepted nutritional requirements, according to Food and Drug Administration scientists who have been analyzing grocery samples collected from chain stores in five American cities.

Each sample, collected every 3 months, contained 60 pounds of groceries and approximated a 1-week food supply for an average 19-year-old boy, the biggest eater in the family. Commodities and quantities in the sample were based on the "moderate income" food list supplied by the Household Economic Research Division of the Department of Agriculture.

The groceries were collected in Washington, D.C., beginning in May 1961, and in Atlanta, Minneapolis, St. Louis, and San Francisco, beginning May 1962. All foods normally cooked were prepared in the National Institute of Health's clinic kitchen.

In most of the samples, no residues of chlorinated hydrocarbons or organic phosphates from pesticides were found; where residue was found, it was never more than a trace and well

within safe tolerance limits set for specific pesticides on individual foods.

Levels of vitamin A, thiamin, riboflavin, and niacin in the samples from all five cities were more than twice the Recommended Dietary Allowances of the Food and Nutrition Board of the National Research Council. Vitamins B<sub>6</sub> and B<sub>12</sub> were well above amounts estimated as required for good nutrition. Methods of preparing samples for study destroyed vitamins C and D, but other studies have shown these to be adequately supplied.

In the following table, the average 1-day vitamin supply from food samples collected in Washington, D.C., the first four quarters of study is compared with vitamin content in Recommended Dietary Allowance:

	<i>Washington, D.C., samples (1-day supply)</i>	<i>Recommended Dietary Allowance (per day)</i>
Vitamin A-----	11,200 IU	5,000 IU
Thiamin -----	2.9 mg.	1.2 mg.
Riboflavin -----	4.1 mg.	1.9 mg.
Niacin -----	33.9 mg.	16.0 mg.
Vitamin B <sub>6</sub> -----	2.7 mg.	( <sup>1</sup> )
Vitamin B <sub>12</sub> -----	21.1 µg.	( <sup>1</sup> )

<sup>1</sup> Recommended allowances have not been established.